What is claimed is:

1. A method comprising:

providing a substrate; and

depositing metal or a metal containing material on the surface of said substrate; said depositing including contacting said substrate surface with an organometallic compound of the formula $(R^1)_mM(PR^2_3)_x$, where M is a metal selected from a Group VIIb,VIII, IX or X metal wherein (a) when M is manganese, technetium, or rhenium, m is 1; x is 5 and m+x is 6; (b) when M is iron, ruthenium or osmium, m is 0, 1, 2, 3 or 4; x is 2, 3, 4 or 5 and m + x is 4, 5, 6 or 7; (c) when M is cobalt, rhodium or iridium, m is 1, 2, 3 or 4 and x is 2, 3 or 4 and m + x is 4, 5, 6, 7 or 8; and (d) when M is nickel, palladium or platinum, m is 0 or 2, x is 2, 3 or 4 and m + x is 2, 3, 4, 5 or 6; each R^1 is independently selected from the group consisting of hydrogen, deuterium, N_2, H_2, D_2 and a group of the formula $-CR^3_2-CR^3_2-R^4$; each R^2 is independently selected from the group consisting of lower alkyl, aryl, arylalkyl, alkoxy, aryloxy, arylalkoxy, alkylsilyl, arylsilyl, arylalkylsilyl, alkoxysilyl, aryloxysilyl, arylalkoxysilyl, alkylsiloxy, arylsiloxy, arylalkylsiloxy, alkoxysiloxy, aryloxysiloxy, arylalkoxysiloxy, alkylsilylalkyl, arylsilylalkyl, arylalkysilylalkyl, alkoxysilylalkyl, aryloxysilylalkyl, arylalkoxysilylalkyl, alkylsiloxyalkyl, arylsiloxyalkyl, arylalkylsiloxyalkyl, alkoxysiloxyalkyl, aryloxysiloxyalkyl, arylalkoxysiloxyalkyl, alkylsilylalkoxy, arylsilylalkoxy, arylalkylsilylalkoxy, alkoxysilylalkoxy, aryloxysilylalkoxy arylalkyloxysilylalkoxy, alkylsiloxyalkoxy, arylsiloxyalkoxy, arylalkylsiloxyalkoxy, alkoxysiloxyalkoxy, aryloxysiloxyalkoxy, and arylalkoxysiloxyalkoxy; each R^3 is independently selected from the group consisting of hydrogen, deuterium, C_1-C_6 alkyl, C_1-C_6 cycloalkyl, phenyl, benzyl,

(C_1-C_2 alkyl or alkoxy)$_3$-silyl, and (C_1-C_2 alkyl or alkoxy)$_3$-siloxy and wherein at least two groups R^3 are selected from the group consisting of hydrogen and deuterium; when R^4 is hydrogen or deuterium; and wherein when M is cobalt and one group R^1 is selected to be N_2, then m is 2 and the second group R^1 is hydrogen or deuterium.

2. The method of claim 1 wherein M is cobalt.

3. The method of claim 1 wherein said depositing comprises the thermal decomposition of said metal compound on said substrate surface.

4. The method of claim 3 wherein said depositing is by chemical vapor deposition.

5. The method of claim 1 wherein said depositing comprises the surface catalyzed decomposition of said metal compound on said substrate surface at a temperature below the thermal decomposition temperature of said metal compound.

6. The method of claim 5 wherein said depositing is by chemical vapor deposition.

7. The method of claim 1 wherein R^1 is hydrogen.

8. The method of claim 1 wherein said R^2 groups are not all the same.

9. The method of claim 8 wherein R^1 is hydrogen.

10. The method of claim 1 wherein M is iron, ruthenium or osmium.

11. The method of claim 10 wherein R^1 is H and R^2 is OR^5 or OR^6 where R^5 is lower alkyl, aryl, arylalkyl, or alkylsilyl and R^6 is lower alkyl.

12. The method of claim 11 wherein the compound is selected from the group consisting of $H_2M[P(OCH_3)_3]_4$, $H_2M[P(OC_2H_5)_3]_4$, $H_2M[P(OC_3H_7)_3]_4$, $H_2M[P(OCH(CH_3)_2)_3]_4$, $H_2M[P(OC_4H_9)_3]_4$, $H_2M[P(OCH(CH_3)(CH_2CH_3))_3]_4$, $H_2M[P(OCH_2CH(CH_3)_2)_3]_4$, $H_2M[(C_6H_5)OP(OCH_3)_2]_4$, $H_2M[(C_6H_5)OP(OC_2H_5)_2]_4$, $H_2M[(C_6H_5)CH_2OP(OCH_3)_2]_4$, $H_2M[(C_6H_5)CH_2OP(OC_2H_5)_2]_4$, $H_2M[(C_3H_7)OP(OCH_3)_2]_4$, $H_2M[(CH_3)_3COP(OC_2H_5)_2]_4$, $H_2M[(C_2H_5)OP(OCH_3)_2]_4$, $H_2M[(C_4H_9)OP(OC_2H_5)_2]_4$, $H_2M[(C_4H_9)OP(OCH_3)_2]_4$, $H_2M[(CH_3)_3SiOP(OCH_3)_2]_4$, $H_2M[(CH_3)_3SiOP(OC_2H_5)_2]_4$, $H_2M[(C_2H_5)_3SiOP(OCH_3)_2]_4$, and $H_2M[(C_2H_5)_3SiOP(OC_2H_5)_2]_4$.

13. The method of claim 10 wherein m is 0 and R^2 is OR^5 or OR^6 where R^5 is lower alkyl, aryl, arylalkyl, or alkylsilyl and R^6 is lower alkyl.

14. The method of claim13 wherein the compound is selected from the group consisting of $M[(C_6H_5)OP(OCH_3)_2]_5$, $M[(C_6H_5)OP(OC_2H_5)_2]_5$, $M[(C_6H_5)CH_2OP(OCH_3)_2]_5$, $M[(C_6H_5)CH_2OP(OC_2H_5)_2]_5$, $M[(C_3H_7)OP(OCH_3)_2]_5$, $M[(C_4H_9)OP(OC_2H_5)_2]_5$, $M[(CH_3)OP(OC_2H_5)_2]_5$, $M[(C_2H_5)OP(OCH_3)_2]_5$, and $M[(C_4H_9)OP(OCH_3)_2]_5$, $M[(CH_3)_3SiOP(OCH_3)_2]_5$, $M[(CH_3)_3SiOP(OC_2H_5)_2]_5$, $M[(C_2H_5)_3SiOP(OCH_3)_2]_5$, and $M[(C_2H_5)_3SiOP(OC_2H_5)_2]_5$.

15. The method of claim 14 wherein M is iron.

16. The method of claim 14 wherein M is ruthenium.

17. The method of claim 14 wherein M is osmium.

18. The method of claim 1 wherein M is cobalt, rhodium or iridium.

19. The method of claim 18 wherein R^1 is H and R^2 is either OR^5 or OR^6 where R^5 is lower alkyl, aryl, arylalkyl, or alkylsilyl and R^6 is lower alkyl.

20. The method of claim 19 wherein M is cobalt and the compound is selected from the group consisting of $HCo[P(OCH_3)_3]_4$, $HCo[P(OC_2H_5)_3]_4$, $HCo[P(OC_3H_7)_3]_4$, $HCo[P(OCH(CH_3)_2)_3]_4$, $HCo[P(OC_4H_9)_3]_4$, $HCo[P(OCH(CH_3)(CH_2CH_3))_3]_4$, $HCo[P(OCH_2CH(CH_3)_2)_3]_4$, $HCo[(C_6H_5)OP(OCH_3)_2]_4$, $HCo[(C_6H_5)OP(OC_2H_5)_2]_4$, $HCo[(C_6H_5)CH_2OP(OCH_3)_2]_4$, $HCo[(C_6H_5)CH_2OP(OC_2H_5)_2]_4$, $HCo[(C_3H_7)OP(OCH_3)_2]_4$, $HCo[(CH_3)_3COP(OC_2H_5)_2]_4$, $HCo[(CH_3)OP(OC_2H_5)_2]_4$ $HCo[(C_2H_5)OP(OCH_3)_2]_4$, $HCo[(C_4H_9)OP(OC_2H_5)_2]_4$, $HCo[(C_4H_9)OP(OCH_3)_2]_4$, $HCo[(CH_3)_3SiOP(OCH_3)_2]_4$, $HCo[(CH_3)_3SiOP(OC_2H_5)_2]_4$, $HCo[(C_2H_5)_3SiOP(OCH_3)_2]_4$, and $HCo[(C_2H_5)_3SiOP(OC_2H_5)_2]_4$.

21. The method of claim 19 wherein M is rhodium and the compound is selected from the group consisting of $HRh[P(OCH_3)_3]_4$, $HRh[P(OC_2H_5)_3]_4$,

$HRh[P(OC_3H_7)_3]_4$, $HRh[P(OCH(CH_3)_2)_3]_4$, $HRh[P(OC_4H_9)_3]_4$,
$HRh[P(OCH(CH_3)(CH_2CH_3))_3]_4$, $HRh[P(OCH_2CH(CH_3)_2)_3]_4$,
$HRh[(C_6H_5)OP(OCH_3)_2]_4$, $HRh[(C_6H_5)OP(OC_2H_5)_2]_4$, $HRh[(C_6H_5)CH_2OP(OCH_3)_2]_4$,
$HRh[(C_6H_5)CH_2OP(OC_2H_5)_2]_4$, $HRh[(C_3H_7)OP(OCH_3)_2]_4$,
$HRh[(CH_3)_3COP(OC_2H_5)_2]_4$, $HRh[(C_2H_5)OP(OCH_3)_2]_4$, $HRh[(C_4H_9)OP(OC_2H_5)_2]_4$,
$HRh[(C_4H_9)OP(OCH_3)_2]_4$, $HRh[(CH_3)_3SiOP(OCH_3)_2]_4$, $HRh[(CH_3)_3SiOP(OC_2H_5)_2]_4$,
$HRh[(C_2H_5)_3SiOP(OCH_3)_2]_4$, and $HRh[(C_2H_5)_3SiOP(OC_2H_5)_2]_4$.

22. The method of claim 19 wherein M is iridium and the compound is selected from the group consisting of $H_3Ir[P(OCH_3)_3]_3$, $H_3Ir[P(OC_2H_5)_3]_3$,
$H_3Ir[P(OC_3H_7)_3]_3$, $H_3Ir[P(OCH(CH_3)_2)_3]_3$, $H_3Ir[P(OC_4H_9)_3]_3$,
$H_3Ir[P(OCH(CH_3)(CH_2CH_3))_3]_3$, $H_3Ir[P(OCH_2CH(CH_3)_2)_3]_3$,
$H_3Ir[(C_6H_5)OP(OCH_3)_2]_3$, $H_3Ir[(C_6H_5)OP(OC_2H_5)_2]_3$, $H_3Ir[(C_6H_5)CH_2OP(OCH_3)_2]_3$,
$H_3Ir[(C_6H_5)CH_2OP(OC_2H_5)_2]_3$, $H_3Ir[(C_3H_7)OP(OCH_3)_2]_3$,
$H_3Ir[(CH_3)_3COP(OC_2H_5)_2]_3$, $H_3Ir[(C_2H_5)OP(OCH_3)_2]_3$, $H_3Ir[(C_4H_9)OP(OC_2H_5)_2]_3$,
$H_3Ir[(C_4H_9)OP(OCH_3)_2]_3$, $H_3Ir[(CH_3)_3SiOP(OCH_3)_2]_3$, $H_3Ir[(CH_3)_3SiOP(OC_2H_5)_2]_3$,
$H_3Ir[(C_2H_5)_3SiOP(OCH_3)_2]_3$, $H_3Ir[(C_2H_5)_3SiOP(OC_2H_5)_2]_3$,
$H_5Ir[(C_6H_5)OP(OC_2H_5)_2]_2$, $H_5Ir[(C_6H_5)CH_2OP(OCH_3)_2]_2$,
$H_5Ir[(C_6H_5)CH_2OP(OC_2H_5)_2]_2$, $H_5Ir[(C_3H_7)OP(OCH_3)_2]_2$, $H_5Ir[(C_4H_9)OP(OC_2H_5)_2]_2$,
$H_5Ir[CH_3OP(OC_2H_5)_2]_2$, $H_5Ir[(C_2H_5)OP(OCH_3)_2]_2$, $H_5Ir[(C_4H_9)OP(OCH_3)_2]_2$,
$H5Ir[(CH_3)_3SiOP(OCH_3)_2]_2$, $H_5Ir[(CH_3)_3SiOP(OC_2H_5)_2]_2$,
$H_5Ir[(C_2H_5)_3SiOP(OCH_3)_2]_2$, and $H_5Ir[(C_2H_5)_3SiOP(OC_2H_5)_2]_2$.

23. The method of claim 1 wherein M is nickel, palladium or platinum.

24. The method of claim 23 wherein m is 0 and R^2 is either OR^5 or OR^6 where R^5 is lower alkyl, arylalkyl, or alkylsilyl and R^6 is lower alkyl.

25. The method of claim 24 wherein the compound is selected from the group consisting of $M[P(OCH_3)_3]_4$, $M[P(OC_2H_5)_3]_4$, $M[P(OC_3H_7)_3]_4$, $M[P(OCH(CH_3)_2)_3]_4$, $M[P(OC_4H_9)_3]_4$, $M[P(OCH(CH_3)(CH_2CH_3))_3]_4$, $M[P(OCH_2CH(CH_3)_2)_3]_4$, $M[(C_6H_5)OP(OCH_3)_2]_4$, $M[(C_6H_5)OP(OC_2H_5)_2]_4$, $M[(C_6H_5)CH_2OP(OCH_3)_2]_4$, $M[(C_6H_5)CH_2OP(OC_2H_5)_2]_4$, $M[(C_3H_7)OP(OCH_3)_2]_4$, $M[(CH_3)_3COP(OC_2H_5)_2]_4$, $M[(C_2H_5)OP(OCH_3)_2]_4$, $M[(C_4H_9)OP(OC_2H_5)_2]_4$, $M[(C_4H_9)OP(OCH_3)_2]_4$, $M[(CH_3)_3SiOP(OCH_3)_2]_4$, $M[(CH_3)_3SiOP(OC_2H_5)_2]_4$, $M[(C_2H_5)_3SiOP(OCH_3)_2]_4$, and $M[(C_2H_5)_3SiOP(OC_2H_5)_2]_4$, $M[(C_6H_5)OP(OCH_3)_2]_2$, $M[(C_6H_5)OP(OC_2H_5)_2]_2$, $M[(C_6H_5)CH_2OP(OCH_3)_2]_2$, $M[(C_6H_5)CH_2OP(OC_2H_5)_2]_2$, $M[(C_3H_7)OP(OCH_3)_2]_2$, $M[(C_4H_9)OP(OC_2H_5)_2]_2$, $M[(CH_3)OP(OC_2H_5)_2]_2$, $M[(C_2H_5)OP(OCH_3)_2]_2$, and $M[(C_4H_9)OP(OCH_3)_2]_2$, $M[(C_6H_5)OP(OCH_3)_2]_3$, $M[(C_6H_5)OP(OC_2H_5)_2]_3$, $M[(C_6H_5)CH_2OP(OCH_3)_2]_3$, $M[(C_6H_5)CH_2OP(OC_2H_5)_2]_3$, $M[(C_3H_7)OP(OCH_3)_2]_3$, $M[(C_4H_9)OP(OC_2H_5)_2]_3$, $M[(CH_3)OP(OC_2H_5)_2]_3$, $M[(C_2H_5)OP(OCH_3)_2]_3$, and $M[(C_4H_9)OP(OCH_3)_2]_3$.

26. The method of claim 25 wherein M is nickel.

27. The method of claim 25 wherein M is palladium.

28. The method of claim 25 wherein M is platinum.

29. The method of claim 4, further comprising providing one or more silicon chemical vapor deposition precursor compounds to react with the metal compound and provide said metal containing material in a form including a metal silicide.

30. The method of claim 29, wherein said one or more silicon chemical vapor deposition precursor compounds includes silane, disilane, or a mixture of silane and disilane.

31. The method of claim 6, further comprising providing one or more silicon chemical vapor deposition precursor compounds to react with the metal compound and provide said metal containing material in a form including metal silicide.

32. The method of claim 31, wherein said one or more silicon chemical vapor deposition precursor compounds includes silane, disilane, or a mixture of silane and disilane.

33. The method of claim 1, wherein the substrate is in the form of an integrated circuit device work piece.

34. The method of claim 33, further comprising selectively depositing the metal containing material to provide electrically conductive contacts for said work piece.

35. The method of claim 34, wherein said work piece includes a number of transistor devices, and one or more electrical contacts are formed by the metal or metal containing material from said depositing.

36. An organometallic compound of the formula $(R^1)_mM(PR^2_3)_x$, where M is a metal selected from the group consisting of manganese, technetium, rhenium, iron, ruthenium, osmium, nickel, palladium, and platinum; each R^1 is independently selected from the group consisting of hydrogen, deuterium, H_2, D_2 and a group of the formula $-CR^3_2-CR^3_2-R^4$, each R^2 is independently selected from the group consisting arylalkyl, arylalkoxy, alkylsilyl, arylsilyl, arylalkylsilyl, alkoxysilyl, aryloxysilyl, arylalkoxysilyl, alkylsiloxy, arylsiloxy, arylalkylsiloxy, alkoxysiloxy, aryloxysiloxy, arylalkoxysiloxy, alkylsilylalkyl, arylsilylalkyl, arylalkysilylalkyl, alkoxysilylalkyl, aryloxysilylalkyl, arylalkoxysilylalkyl, alkylsiloxyalkyl, arylsiloxyalkyl, arylalkylsiloxyalkyl, alkoxysiloxyalkyl, aryloxysiloxyalkyl, arylalkoxysiloxyalkyl, alkylsilylalkoxy, arylsilylalkoxy, arylalkylsilylalkoxy, alkoxysilylalkoxy, aryloxysilylalkoxy arylalkyloxysilylalkoxy, alkylsiloxyalkoxy, arylsiloxyalkoxy, arylalkylsiloxyalkoxy, alkoxysiloxyalkoxy, aryloxysiloxyalkoxy, and arylalkoxysiloxyalkoxy; each R^3 is independently selected from the group consisting of hydrogen, deuterium, C_1-C_6 alkyl, C_1-C_6 cycloalkyl, phenyl, benzyl, (C_1-C_2 alkyl or alkoxy)$_3$-silyl, and (C_1-C_2 alkyl or alkoxy)$_3$-siloxy and wherein at least two groups R^3 are selected from the group consisting of hydrogen and deuterium; R^4 is hydrogen or deuterium; and wherein (a) when M is manganese, technetium or rhenium, m is 1; x is 5 and m+x is 6 and wherein said R^2 groups are not all the same; and (b) when M is iron, ruthenium or osmium m is 0, 1, 2, 3 or 4; x is 2, 3, 4 or 5 and m + x is 4, 5, 6 or 7; and wherein said R^2 groups are not all the same; and (c) when M is nickel,

palladium or platinum m is 0 or 2, x is 2, 3 or 4 and m + x is 2, 3, 4, 5 or 6; and wherein said R^2 groups are not all the same.

37. The compound of claim 36 wherein M is iron, ruthenium or osmium, R^1 is hydrogen and the compound is selected from the group consisting of $H_2M[(C_6H_5)OP(OCH_3)_2]_4$, $H_2M[(C_6H_5)OP(OC_2H_5)_2]_4$, $H_2M[(C_6H_5)CH_2OP(OCH_3)_2]_4$, $H_2M[(C_6H_5)CH_2OP(OC_2H_5)_2]_4$, $H_2M[(C_3H_7)OP(OCH_3)_2]_4$, $H_2M[(C_4H_9)OP(OC_2H_5)_2]_4$, $H_2M[(CH_3)OP(OC_2H_5)_2]_4$, $H_2M[(C_2H_5)OP(OCH_3)_2]_4$, $H_2M[(C_4H_9)OP(OCH_3)_2]_4$, $M[(C_6H_5)OP(OCH_3)_2]_5$, $M[(C_6H_5)OP(OC_2H_5)_2]_5$, $M[(C_6H_5)CH_2OP(OCH_3)_2]_5$, $M[(C_6H_5)CH_2OP(OC_2H_5)_2]_5$, $M[(C_3H_7)OP(OCH_3)_2]_5$, $M[(C_4H_9)OP(OC_2H_5)_2]_5$, $M[(CH_3)OP(OC_2H_5)_2]_5$, $M[(C_2H_5)OP(OCH_3)_2]_5$, and $M[(C_4H_9)OP(OCH_3)_2]_5$.

38. The compound of claim 36 wherein M is nickel, palladium or platinum, m is 0 and the compound is selected from the group consisting of $M[(C_6H_5)OP(OCH_3)_2]_4$, $M[(C_6H_5)OP(OC_2H_5)_2]_4$, $M[(C_6H_5)CH_2OP(OCH_3)_2]_4$, $M[(C_6H_5)CH_2OP(OC_2H_5)_2]_4$, $M[(C_3H_7)OP(OCH_3)_2]_4$, $M[(C_4H_9)OP(OC_2H_5)_2]_4$, $M[(CH_3)OP(OC_2H_5)_2]_4$, $M[(C_2H_5)OP(OCH_3)_2]_4$, $M[(C_4H_9)OP(OCH_3)_2]_4$, $M[(C_6H_5)OP(OCH_3)_2]_3$, $M[(C_6H_5)OP(OC_2H_5)_2]_3$, $M[(C_6H_5)CH_2OP(OCH_3)_2]_3$, $M[(C_6H_5)CH_2OP(OC_2H_5)_2]_3$, $M[(C_3H_7)OP(OCH_3)_2]_3$, $M[(C_4H_9)OP(OC_2H_5)_2]_3$, $M[(CH_3)OP(OC_2H_5)_2]_3$, $M[(C_2H_5)OP(OCH_3)_2]_3$, $M[(C_4H_9)OP(OCH_3)_2]_3$, $M[(C_6H_5)OP(OCH_3)_2]_2$, $M[(C_6H_5)OP(OC_2H_5)_2]_2$, $M[(C_6H_5)CH_2OP(OCH_3)_2]_2$, $M[(C_6H_5)CH_2OP(OC_2H_5)_2]_2$, $M[(C_3H_7)OP(OCH_3)_2]_2$, $M[(C_4H_9)OP(OC_2H_5)_2]_2$, $M[(CH_3)OP(OC_2H_5)_2]_2$, $M[(C_2H_5)OP(OCH_3)_2]_2$, and $M[(C_4H_9)OP(OCH_3)_2]_2$.

39. An organometallic compound of the formula $(R^1)_mM(PR^2_3)_x$, where M is a metal selected from the group consisting of rhodium and iridium; m is 1, 3 or 4; x is 2, 3 or 4; and m + x is 4, 5, 6, 7 or 8; each R^1 is independently selected from the group consisting of hydrogen, deuterium, N_2, H_2, D_2 and a group of the formula - CR^3_2-CR^3_2-R^4; each R^2 is independently selected from the group consisting of arylalkyl, alkoxy, aryloxy, arylalkoxy, alkylsilyl, arylsilyl, arylalkylsilyl, alkoxysilyl, aryloxysilyl, arylalkoxysilyl, alkylsiloxy, arylsiloxy, arylalkylsiloxy, alkoxysiloxy, aryloxysiloxy, arylalkoxysiloxy, alkylsilylalkyl, arylsilylalkyl, arylalkysilylalkyl, alkoxysilylalkyl, aryloxysilylalkyl, arylalkoxysilylalkyl, alkylsiloxyalkyl, arylsiloxyalkyl, arylalkylsiloxyalkyl, alkoxysiloxyalkyl, aryloxysiloxyalkyl, arylalkoxysiloxyalkyl, alkylsilylalkoxy, arylsilylalkoxy, arylalkylsilylalkoxy, alkoxysilylalkoxy, aryloxysilylalkoxy arylalkyloxysilylalkoxy, alkylsiloxyalkoxy, arylsiloxyalkoxy, arylalkylsiloxyalkoxy, alkoxysiloxyalkoxy, aryloxysiloxyalkoxy, and arylalkoxysiloxyalkoxy; each R^3 is independently selected from the group consisting of hydrogen, deuterium, C_1-C_6 alkyl, C_1-C_6 cycloalkyl, phenyl, benzyl, (C_1-C_2 alkyl or alkoxy)$_3$-silyl, and (C_1-C_2 alkyl or alkoxy)$_3$-siloxy and wherein at least two groups R^3 are selected from the group consisting of hydrogen and deuterium; R^4 is hydrogen or deuterium; and wherein said R^2 groups are not all the same.

40. The compound of claim 38 wherein M is rhodium, R^1 is hydrogen and the compound is selected from the group consisting of $HRh[(C_6H_5)OP(OCH_3)_2]_4$, $HRh[(C_6H_5)OP(OC_2H_5)_2]_4$, $HRh[(C_6H_5)CH_2OP(OCH_3)_2]_4$, $HRh[(C_6H_5)CH_2OP(OC_2H_5)_2]_4$, $HRh[(C_3H_7)OP(OCH_3)_2]_4$, $HRh[(C_4H_9)OP(OC_2H_5)_2]_4$, $HRh[(CH_3)OP(OC_2H_5)_2]_4$, $HRh[(C_2H_5)OP(OCH_3)_2]_4$, and $HRh[(C_4H_9)OP(OCH_3)_2]_4$.

41. The compound of claim 39 wherein M is iridium, R^1 is hydrogen and the compound is selected from the group consisting of $H_3Ir[(C_6H_5)OP(OCH_3)_2]_3$, $H_3Ir[(C_6H_5)OP(OC_2H_5)_2]_3$, $H_3Ir[(C_6H_5)CH_2OP(OCH_3)_2]_3$, $H_3Ir[(C_6H_5)CH_2OP(OC_2H_5)_2]_3$, $H_3Ir[(C_3H_7)OP(OCH_3)_2]_3$, $H_3Ir[(C_4H_9)OP(OC_2H_5)_2]_3$, $H_3Ir[(CH_3)OP(OC_2H_5)_2]_3$, $H_3Ir[(C_2H_5)OP(OCH_3)_2]_3$, $H_3Ir[(C_4H_9)OP(OCH_3)_2]_3$, $H_5Ir[(C_6H_5)OP(OC_2H_5)_2]_2$, $H_5Ir[(C_6H_5)CH_2OP(OCH_3)_2]_2$, $H_5Ir[(C_6H_5)CH_2OP(OC_2H_5)_2]_2$, $H_5Ir[(C_3H_7)OP(OCH_3)_2]_2$, $H_5Ir[(C_4H_9)OP(OC_2H_5)_2]_2$, $H_5Ir[(CH_3)OP(OC_2H_5)_2]_2$, $H_5Ir[(C_2H_5)OP(OCH_3)_2]_2$, and $H_5Ir[(C_4H_9)OP(OCH_3)_2]_2$.

42. A cobalt organometallic compound of the formula $(R^1)_mCo(PR^2{}_3)_x$, where m is 1, 2, or 3; x is 3 or 4; m + x is 5 or 6; each R^1 is independently selected from the group consisting of hydrogen, deuterium, N_2, H_2, D_2 and a group of the formula $-CR^3{}_2-CR^3{}_2-R^4$; each R^2 is independently selected from the group consisting of lower alkyl, aryl, arylalkyl, alkoxy, aryloxy, arylalkoxy, alkylsilyl, arylsilyl, arylalkylsilyl, alkoxysilyl, aryloxysilyl, arylalkoxysilyl, alkylsiloxy, arylsiloxy, arylalkylsiloxy, alkoxysiloxy, aryloxysiloxy, arylalkoxysiloxy, alkylsilylalkyl, arylsilylalkyl, arylalkysilylalkyl, alkoxysilylalkyl, aryloxysilylalkyl, arylalkoxysilylalkyl, alkylsiloxyalkyl, arylsiloxyalkyl, arylalkylsiloxyalkyl, alkoxysiloxyalkyl, aryloxysiloxyalkyl, arylalkoxysiloxyalkyl, alkylsilylalkoxy, arylsilylalkoxy, arylalkylsilylalkoxy, alkoxysilylalkoxy, aryloxysilylalkoxy arylalkyloxysilylalkoxy, alkylsiloxyalkoxy, arylsiloxyalkoxy, arylalkylsiloxyalkoxy, alkoxysiloxyalkoxy, aryloxysiloxyalkoxy, and arylalkoxysiloxyalkoxy; each R^3 is independently selected from the group consisting of hydrogen, deuterium, C_1-C_6 alkyl, C_1-C_6 cycloalkyl, phenyl, benzyl, (C_1-C_2 alkyl or alkoxy)$_3$-silyl, and (C_1-C_2

alkyl or alkoxy)$_3$-siloxy and wherein at least two groups R^3 are selected from the group consisting of hydrogen and deuterium; R^4 is hydrogen or deuterium; and wherein when one group R^1 is selected to be N_2, then m is 2 and the second group R^1 is hydrogen or deuterium; and wherein said R^2 groups are not all the same.

43. The compound of claim 42 wherein R^1 is hydrogen and the compound is selected from the group consisting of $HCo[(C_6H_5)OP(OCH_3)_2]_4$, $HCo[(C_6H_5)OP(OC_2H_5)_2]_4$, $HCo[(C_6H_5)CH_2OP(OCH_3)_2]_4$, $HCo[(C_6H_5)CH_2OP(OC_2H_5)_2]_4$, $HCo[(C_3H_7)OP(OCH_3)_2]_4$, $HCo[(C_4H_9)OP(OC_2H_5)_2]_4$, $HCo[(CH_3)OP(OC_2H_5)_2]_4$, $HCo[(C_2H_5)OP(OCH_3)_2]_4$, and $HCo[(C_4H_9)OP(OCH_3)_2]_4$.

44. The compound of claim 36 wherein at least one of R^2 is selected from the group consisting of alkylsilyl, arylsilyl, arylalkylsilyl, alkoxysilyl, aryloxysilyl, arylalkoxysilyl, alkylsiloxy, arylsiloxy, arylalkylsiloxy, alkoxysiloxy, aryloxysiloxy, arylalkoxysiloxy, alkylsilylalkyl, arylsilylalkyl, arylalkysilylalkyl, alkoxysilylalkyl, aryloxysilylalkyl, arylalkoxysilylalkyl, alkylsiloxyalkyl, arylsiloxyalkyl, arylalkylsiloxyalkyl, alkoxysiloxyalkyl, aryloxysiloxyalkyl, arylalkoxysiloxyalkyl, alkylsilylalkoxy, arylsilylalkoxy, arylalkylsilylalkoxy, alkoxysilylalkoxy, aryloxysilylalkoxy arylalkyloxysilylalkoxy, alkylsiloxyalkoxy, arylsiloxyalkoxy, arylalkylsiloxyalkoxy, alkoxysiloxyalkoxy, aryloxysiloxyalkoxy, and arylalkoxysiloxyalkoxy.

45. The compound of claim 44 wherein M is iron, ruthenium, or osmium and the compound is selected from the group consisting of

$H_2M[(CH_3)_3SiOP(OCH_3)_2]_4$, $H_2M[(CH_3)_3SiOP(OC_2H_5)_2]_4$, $H_2M[(C_2H_5)_3SiOP(OCH_3)_2]_4$, $H_2M[(C_2H_5)_3SiOP(OC_2H_5)_2]_4$, $M[(CH_3)_3SiOP(OCH_3)_2]_5$, $M[(CH_3)_3SiOP(OC_2H_5)_2]_5$, $M[(C_2H_5)_3SiOP(OCH_3)_2]_5$, and $M[(C_2H_5)_3SiOP(OC_2H_5)_2]_5$.

46. The compound of claim 44 wherein M is nickel, palladium or platinum and the compound is selected from the group consisting of $M[(CH_3)_3SiOP(OCH_3)_2]_4$, $M[(CH_3)_3SiOP(OC_2H_5)_2]_4$, $M[(C_2H_5)_3SiOP(OCH_3)_2]_4$, and $M[(C_2H_5)_3SiOP(OC_2H_5)_2]_4$.

47. The compound of claim 39 wherein at least one of R^2 is selected from the group consisting of alkylsilyl, arylsilyl, arylalkylsilyl, alkoxysilyl, aryloxysilyl, arylalkoxysilyl, alkylsiloxy, arylsiloxy, arylalkylsiloxy, alkoxysiloxy, aryloxysiloxy, arylalkoxysiloxy, alkylsilylalkyl, arylsilylalkyl, arylalkysilylalkyl, alkoxysilylalkyl, aryloxysilylalkyl, arylalkoxysilylalkyl, alkylsiloxyalkyl, arylsiloxyalkyl, arylalkylsiloxyalkyl, alkoxysiloxyalkyl, aryloxysiloxyalkyl, arylalkoxysiloxyalkyl, alkylsilylalkoxy, arylsilylalkoxy, arylalkylsilylalkoxy, alkoxysilylalkoxy, aryloxysilylalkoxy arylalkyloxysilylalkoxy, alkylsiloxyalkoxy, arylsiloxyalkoxy, arylalkylsiloxyalkoxy, alkoxysiloxyalkoxy, aryloxysiloxyalkoxy, and arylalkoxysiloxyalkoxy.

48. The compound of claim 47 wherein M is rhodium and the compound is selected from the group consisting of $HRh[(CH_3)_3SiOP(OCH_3)_2]_4$, $HRh[(CH_3)_3SiOP(OC_2H_5)_2]_4$, $HRh[(C_2H_5)_3SiOP(OCH_3)_2]_4$, and $HRh[(C_2H_5)_3SiOP(OC_2H_5)_2]_4$.

49. The compound of claim 47 wherein M is iridium and the compound is selected from the group consisting of $H_3Ir[(CH_3)_3SiOP(OCH_3)_2]_3$, $H_3Ir[(CH_3)_3SiOP(OC_2H_5)_2]_3$, $H_3Ir[(C_2H_5)_3SiOP(OCH_3)_2]_3$, $H_3Ir[(C_2H_5)_3SiOP(OC_2H_5)_2]_3$, $H_5Ir[(CH_3)_3SiOP(OCH_3)_2]_2$, $H_5Ir[(CH_3)_3SiOP(OC_2H_5)_2]_2$, $H_5Ir[(C_2H_5)_3SiOP(OCH_3)_2]_2$, and $H_5Ir[(C_2H_5)_3SiOP(OC_2H_5)_2]_2$.

50. The compound of claim 42 wherein at least one of R^2 is selected from the group consisting of alkylsilyl, arylsilyl, arylalkylsilyl, alkoxysilyl, aryloxysilyl, arylalkoxysilyl, alkylsiloxy, arylsiloxy, arylalkylsiloxy, alkoxysiloxy, aryloxysiloxy, arylalkoxysiloxy, alkylsilylalkyl, arylsilylalkyl, arylalkysilylalkyl, alkoxysilylalkyl, aryloxysilylalkyl, arylalkoxysilylalkyl, alkylsiloxyalkyl, arylsiloxyalkyl, arylalkylsiloxyalkyl, alkoxysiloxyalkyl, aryloxysiloxyalkyl, arylalkoxysiloxyalkyl, alkylsilylalkoxy, arylsilylalkoxy, arylalkylsilylalkoxy, alkoxysilylalkoxy, aryloxysilylalkoxy arylalkyloxysilylalkoxy, alkylsiloxyalkoxy, arylsiloxyalkoxy, arylalkylsiloxyalkoxy, alkoxysiloxyalkoxy, aryloxysiloxyalkoxy, and arylalkoxysiloxyalkoxy.

51. The compound of claim 50 wherein the compound is selected from the group consisting of $HCo[(CH_3)_3SiOP(OCH_3)_2]_4$, $HCo[(CH_3)_3SiOP(OC_2H_5)_2]_4$, $HCo[(C_2H_5)_3SiOP(OCH_3)_2]_4$, and $HCo[(C_2H_5)_3SiOP(OC_2H_5)_2]_4$.

52. A method of chemical deposition of metal on a substrate surface comprising:

contacting the substrate surface with an organometallic precursor compound of the formula $(R^1)_mM(PR^2_3)_x$, where M is a metal selected from the group consisting of manganese, technetium, rhenium, iron, ruthenium, osmium, cobalt, rhodium, iridium, nickel, palladium, and platinum wherein (a) when M is manganese, technetium or rhenium, m is 1, x is 5 and m+x is 6; (b) when M is iron, ruthenium or osmium, m is 0, 1, 2, 3 or 4; x is 2, 3, 4 or 5 and m + x is 4, 5, 6, or 7; (c) when M is cobalt, rhodium or iridium, m is 1, 2, 3 or 4 and x is 2, 3 or 4 and m + x is 4, 5, 6, 7 or 8; and (d) when M is nickel, palladium or platinum, m is 0 or 2, x is 2, 3 or 4 and m + x is 2, 3, 4, 5 or 6; each R^1 is independently selected from the group consisting of hydrogen, deuterium, N_2, H_2, D_2 and a group of the formula $-CR^3_2-CR^3_2-R^4$; each R^2 is independently selected from the group consisting of lower alkyl, aryl, arylalkyl, alkoxy, aryloxy, arylalkoxy, alkylsilyl, arylsilyl, arylalkylsilyl, alkoxysilyl, aryloxysilyl, arylalkoxysilyl, alkylsiloxy, arylsiloxy, arylalkylsiloxy, alkoxysiloxy, aryloxysiloxy, arylalkoxysiloxy, alkylsilylalkyl, arylsilylalkyl, arylalkysilylalkyl, alkoxysilylalkyl, aryloxysilylalkyl, arylalkoxysilylalkyl, alkylsiloxyalkyl, arylsiloxyalkyl, arylalkylsiloxyalkyl, alkoxysiloxyalkyl, aryloxysiloxyalkyl, arylalkoxysiloxyalkyl, alkylsilylalkoxy, arylsilylalkoxy, arylalkylsilylalkoxy, alkoxysilylalkoxy, aryloxysilylalkoxy arylalkyloxysilylalkoxy, alkylsiloxyalkoxy, arylsiloxyalkoxy, arylalkylsiloxyalkoxy, alkoxysiloxyalkoxy, aryloxysiloxyalkoxy, and arylalkoxysiloxyalkoxy; each R^3 is independently selected from the group consisting of hydrogen, deuterium, C_1-C_6 alkyl, C_1-C_6 cycloalkyl, phenyl, benzyl, (C_1-C_2 alkyl or alkoxy)$_3$-silyl, and (C_1-C_2 alkyl or alkoxy)$_3$-siloxy and wherein at least two groups R^3 are selected from the group consisting of hydrogen and deuterium; R^4 is hydrogen or deuterium; and wherein when M is cobalt, rhodium or iridium and one

group R^1 is selected to be N_2, then m is 2 and the second group R^1 is hydrogen or deuterium; and

heating an area of the substrate surface desired to be coated to a temperature at or above the thermal decomposition temperature of the organometallic precursor compound.

53. The method of claim 52 wherein M is cobalt.

54. The method of claim 52 wherein the compound is in a liquid state as it contacts the substrate surface.

55. The method of claim 52 wherein the compound is in a vapor state as it contacts the substrate surface.

56. The method of claim 55 wherein said contacting further includes contacting the heated surface with an inert carrier gas, a vaporized reducing agent, or a mixture of an inert carrier gas and a vaporized reducing agent.

57. The method of claim 56 wherein the reducing agent is hydrogen.

58. The method of claim 55 wherein said contacting further includes contacting the heated substrate surface with at least one non-metal containing chemical vapor deposition precursor compound.

59. The method of claim 58 wherein said at least one non-metal containing chemical vapor deposition precursor compound includes silane, disilane or a mixture of silane and disilane.

60. A film including a metal, obtainable by chemical vapor deposition of an organometallic compound of the formula $(R^1)_mM(PR^2_3)_x$, where M is a metal selected from the group consisting of manganese, technetium, rhenium, iron, ruthenium, osmium, cobalt, rhodium, iridium, nickel, palladium, and platinum wherein (a) when M is manganese, technetium, or rhenium, m is 1, x is 5 and m+x is 6; (b) when M is iron, ruthenium or osmium, m is 0, 1, 2, 3 or 4; x is 2, 3, 4 or 5 and m + x is 4, 5, 6 or 7; (c) when M is cobalt, rhodium or iridium, m is 1, 2, 3 or 4 and x is 2, 3 or 4 and m + x is 4, 5, 6, 7 or 8; and (d) when M is nickel, palladium or platinum, m is 0 or 2, x is 2, 3, or 4 and m + x is 2, 3, 4, 5 or 6; each R^1 is independently selected from the group consisting of hydrogen, deuterium, N_2, H_2, D_2 and a group of the formula $-CR^3_2-CR^3_2-R^4$; each R^2 is independently selected from the group consisting of lower alkyl, aryl, arylalkyl, alkoxy, aryloxy, arylalkoxy, alkylsilyl, arylsilyl, arylalkylsilyl, alkoxysilyl, aryloxysilyl, arylalkoxysilyl, alkylsiloxy, arylsiloxy, arylalkylsiloxy, alkoxysiloxy, aryloxysiloxy, arylalkoxysiloxy, alkylsilylalkyl, arylsilylalkyl, arylalkysilylalkyl, alkoxysilylalkyl, aryloxysilylalkyl, arylalkoxysilylalkyl, alkylsiloxyalkyl, arylsiloxyalkyl, arylalkylsiloxyalkyl, alkoxysiloxyalkyl, aryloxysiloxyalkyl, arylalkoxysiloxyalkyl, alkylsilylalkoxy, arylsilylalkoxy, arylalkylsilylalkoxy, alkoxysilylalkoxy, aryloxysilylalkoxy arylalkyloxysilylalkoxy, alkylsiloxyalkoxy, arylsiloxyalkoxy, arylalkylsiloxyalkoxy, alkoxysiloxyalkoxy, aryloxysiloxyalkoxy, and arylalkoxysiloxyalkoxy; each R^3 is independently selected from the group consisting of hydrogen, deuterium, C_1-C_6

alkyl, C_1-C_6 cycloalkyl, phenyl, benzyl, (C_1-C_2 alkyl or alkoxy)$_3$-silyl, and (C_1-C_2 alkyl or alkoxy)$_3$-siloxy and wherein at least two groups R^3 are selected from the group consisting of hydrogen and deuterium; R^4 is hydrogen or deuterium; and wherein when M is cobalt and one group R^1 is selected to be N_2, then m is 2 and the second group R^1 is hydrogen or deuterium.

61. The film according to claim 60 wherein M is cobalt.

62. The film of claim 60 wherein at least a portion of the metal is in the form of a metal silicide.

63. A method comprising:

providing an integrated circuit device work piece; and

depositing a metal or a metal containing material on the work piece; said depositing including contacting said work piece or a portion thereof with an organometallic compound of the formula $(R^1)_mM(PR^2_3)_x$, where M is a metal selected from the group consisting of manganese, technetium, rhenium, iron, ruthenium, osmium, cobalt, rhodium, iridium, nickel, palladium, and platinum wherein (a) when M is manganese, technetium, or rhenium, m is 1, x is 5 and m+x is 6; (b) when M is iron, ruthenium or osmium, m is 0, 1, 2, 3 or 4; x is 2, 3, 4 or 5 and m + x is 4, 5, 6 or 7; (c) when M is cobalt, rhodium or iridium, m is 1, 2, 3 or 4 and x is 2, 3 or 4 and m + x is 4, 5, 6, 7 or 8; and (d) when M is nickel, palladium or platinum, m is 0 or 2, x is 2, 3, or 4 and m + x is 2, 3, 4, 5 or 6; each R^1 is independently selected from the group consisting of hydrogen, deuterium, N_2, H_2, D_2 and a group of the formula -CR^3_2-CR^3_2-R^4; each R^2 is independently selected from the group consisting of lower

alkyl, aryl, arylalkyl, alkoxy, aryloxy, arylalkoxy, alkylsilyl, arylsilyl, arylalkylsilyl, alkoxysilyl, aryloxysilyl, arylalkoxysilyl, alkylsiloxy, arylsiloxy, arylalkylsiloxy, alkoxysiloxy, aryloxysiloxy, arylalkoxysiloxy, alkylsilylalkyl, arylsilylalkyl, arylalkysilylalkyl, alkoxysilylalkyl, aryloxysilylalkyl, arylalkoxysilylalkyl, alkylsiloxyalkyl, arylsiloxyalkyl, arylalkylsiloxyalkyl, alkoxysiloxyalkyl, aryloxysiloxyalkyl, arylalkoxysiloxyalkyl, alkylsilylalkoxy, arylsilylalkoxy, arylalkylsilylalkoxy, alkoxysilylalkoxy, aryloxysilylalkoxy arylalkyloxysilylalkoxy, alkylsiloxyalkoxy, arylsiloxyalkoxy, arylalkylsiloxyalkoxy, alkoxysiloxyalkoxy, aryloxysiloxyalkoxy, and arylalkoxysiloxyalkoxy; each R^3 is independently selected from the group consisting of hydrogen, deuterium, C_1-C_6 alkyl, C_1-C_6 cycloalkyl, phenyl, benzyl, (C_1-C_2 alkyl or alkoxy)$_3$-silyl, and (C_1-C_2 alkyl or alkoxy)$_3$-siloxy and wherein at least two groups R^3 are selected from the group consisting of hydrogen and deuterium; R^4 is hydrogen or deuterium; and wherein when M is cobalt and one group R^1 is selected to be N_2, then m is 2 and the second group R^1 is hydrogen or deuterium.

64. The method according to claim 63 wherein M is cobalt.

65. The method of claim 64 wherein said depositing is by chemical vapor deposition.

66. The method of claim 65, further comprising providing one or more silicon chemical vapor deposition precursor compounds to react with the metal compound and provide said metal containing material in a form including a metal silicide.

67. The method of claim 66, wherein said one or more silicon chemical vapor deposition precursor compounds includes silane, disilane, or a mixture of silane and disilane.

68. The method of claim 63, wherein said R^2 groups are not all the same.

69. The method of claim 63 wherein m is 0.

70. The method of claim 68, wherein R^1 is hydrogen or deuterium.

71. The method of claim 63, further comprising selectively depositing the metal or metal containing material to provide electrically conductive contacts for the work piece.

72. The method of claim 63, wherein the work piece includes a number of transistor devices, and further comprising providing one or more electrical contacts for the transistor devices from the metal or metal containing material.

73. The method of claim 72, wherein said transistors devices are insulated gate field effect transistors.

74. An integrated circuit device having a film obtainable by chemical vapor deposition of an organometallic compound of the formula $(R^1)_mM(PR^2{}_3)_x$, where M is a metal selected from the group consisting of manganese, technetium, rhenium, iron, ruthenium, osmium, cobalt, rhodium, iridium, nickel, palladium, and

platinum wherein (a) when M is manganese, technetium or rhenium, m is 1, x is 5 and m+x is 6; (b) when M is iron, ruthenium or osmium, m is 0, 1, 2, 3 or 4; x is 2, 3, 4 or 5 and m + x is 4, 5, 6 or 7; (c) when M is cobalt, rhodium or iridium, m is 1, 2, 3 or 4 and x is 2, 3 or 4 and m + x is 4, 5, 6, 7 or 8; and (d) when M is nickel, palladium or platinum, m is 0 or 2, x is 2, 3, or 4 and m + x is 2, 3, 4, 5 or 6; each R^1 is independently selected from the group consisting of hydrogen, deuterium, N_2, H_2, D_2 and a group of the formula $-CR^3_2-CR^3_2-R^4$; each R^2 is independently selected from the group consisting of lower alkyl, aryl, arylalkyl, alkoxy, aryloxy, arylalkoxy, alkylsilyl, arylsilyl, arylalkylsilyl, alkoxysilyl, aryloxysilyl, arylalkoxysilyl, alkylsiloxy, arylsiloxy, arylalkylsiloxy, alkoxysiloxy, aryloxysiloxy, arylalkoxysiloxy, alkylsilylalkyl, arylsilylalkyl, arylalkysilylalkyl, alkoxysilylalkyl, aryloxysilylalkyl, arylalkoxysilylalkyl, alkylsiloxyalkyl, arylsiloxyalkyl, arylalkylsiloxyalkyl, alkoxysiloxyalkyl, aryloxysiloxyalkyl, arylalkoxysiloxyalkyl, alkylsilylalkoxy, arylsilylalkoxy, arylalkylsilylalkoxy, alkoxysilylalkoxy, aryloxysilylalkoxy arylalkyloxysilylalkoxy, alkylsiloxyalkoxy, arylsiloxyalkoxy, arylalkylsiloxyalkoxy, alkoxysiloxyalkoxy, aryloxysiloxyalkoxy, and arylalkoxysiloxyalkoxy; each R^3 is independently selected from the group consisting of hydrogen, deuterium, C_1-C_6 alkyl, C_1-C_6 cycloalkyl, phenyl, benzyl, (C_1-C_2 alkyl or alkoxy)$_3$-silyl, and (C_1-C_2 alkyl or alkoxy)$_3$-siloxy and wherein at least two groups R^3 are selected from the group consisting of hydrogen and deuterium; R^4 is hydrogen or deuterium; and wherein when M is cobalt and one group R^1 is selected to be N_2, then m is 2 and the second group R^1 is hydrogen or deuterium.

75. The integrated circuit device of claim 74 wherein M is cobalt.

76. A method for forming a powder containing a metal or metal derivative comprising:

providing a medium; and

dispersing a vapor or liquid into the medium, the vapor or liquid containing an organometallic compound of the formula $(R^1)_mM(PR^2_3)_x$, where M is a metal selected from a Group VIIb, VIII, IX or X metal wherein (a) when M is manganese, technetium or rhenium, m is 1, x is 5 and m+x is 6; (b) when M is iron, ruthenium or osmium, m is 0, 1, 2, 3 or 4; x is 2, 3, 4 or 5 and m + x is 4, 5, 6 or 7; (c) when M is cobalt, rhodium or iridium, m is 1, 2, 3 or 4 and x is 2, 3 or 4 and m + x is 4, 5, 6, 7 or 8; and (d) when M is nickel, palladium or platinum, m is 0 or 2, x is 2, 3 or 4 and m + x is 2, 3, 4, 5 or 6; each R^1 is independently selected from the group consisting of hydrogen, deuterium, N_2, H_2, D_2 and a group of the formula $-CR^3_2-CR^3_2-R^4$; each R^2 is independently selected from the group consisting of lower alkyl, aryl, arylalkyl, alkoxy, aryloxy, arylalkoxy, alkylsilyl, arylsilyl, arylalkylsilyl, alkoxysilyl, aryloxysilyl, arylalkoxysilyl, alkylsiloxy, arylsiloxy, arylalkylsiloxy, alkoxysiloxy, aryloxysiloxy, arylalkoxysiloxy, alkylsilylalkyl, arylsilylalkyl, arylalkysilylalkyl, alkoxysilylalkyl, aryloxysilylalkyl, arylalkoxysilylalkyl, alkylsiloxyalkyl, arylsiloxyalkyl, arylalkylsiloxyalkyl, alkoxysiloxyalkyl, aryloxysiloxyalkyl, arylalkoxysiloxyalkyl, alkylsilylalkoxy, arylsilylalkoxy, arylalkylsilylalkoxy, alkoxysilylalkoxy, aryloxysilylalkoxy arylalkyloxysilylalkoxy, alkylsiloxyalkoxy, arylsiloxyalkoxy, arylalkylsiloxyalkoxy, alkoxysiloxyalkoxy, aryloxysiloxyalkoxy, and arylalkoxysiloxyalkoxy; each R^3 is independently selected from the group consisting of hydrogen, deuterium, C_1-C_6 alkyl, C_1-C_6 cycloalkyl, phenyl, benzyl, (C_1-C_2 alkyl or alkoxy)$_3$-silyl, and (C_1-C_2 alkyl or alkoxy)$_3$-siloxy and wherein at least two groups R^3 are selected from the group consisting of hydrogen and deuterium, R^4

is hydrogen or deuterium; and wherein when M is cobalt and one group R^1 is selected to be N_2, then m is 2 and the second group R^1 is hydrogen or deuterium.

77. The method of claim 76 wherein the medium is at a temperature at or above the thermal decomposition temperature of the organometallic precursor compound.